

# Data analysis of volatile organic compounds (VOCs) in Canada: spatiotemporal trends and other patterns related to Volatile Chemical Products (VCPs)

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## Introduction

- Volatile organic compounds (VOCs) are chemicals that have high vapour pressure. [1]
- VOCs react in the atmosphere to form ozone and particulate matter, contributing to urban air pollution. [2]
- Recent studies in the United States (McDonald et. al., 2018) point to Volatile Chemical Products (VCPs) as significant emerging sources of VOC emissions. [3]

### Transportation sources



Car exhaust

### Volatile Chemical Products (VCPs)



Eg. Paints, coatings, varnishes, solvents, personal care products

## Objective

VCPs regulations are driven by toxicological rather than air quality concerns. [4] There is a need to determine the nature of VCP-related emissions to further inform environmental policies.

## Hypothesis

VOCs commonly found in VCPs will **increase** over time while other VOCs decrease. They will have a **strong & increasing** relationship with population density (**higher** than vehicular VOCs).

## Methods

VOC data was downloaded from the publicly-available Canadian National Air Pollution Surveillance (NAPS) database.



Fig. 1: Map of NAPS stations (grey markers). 110 stations were surveyed over 30 years

1. Data was cleaned and selected.
2. Data distribution (average and spread) was assessed with median and interquartile range (IQR) every 5 years.
3. Temporal changes were modelled with time series and Simple Moving Average (SMA) smoothing.
4. Simple linear regression model with population density.

## Results and Discussion

### Spatiotemporal trends

- Most VOC emissions (median, interquartile range) **decreased** over the years.
- **Dichloromethane (DCM)** concentration is increasing in most provinces across Canada.

Dichloromethane concentration over the years in British Columbia

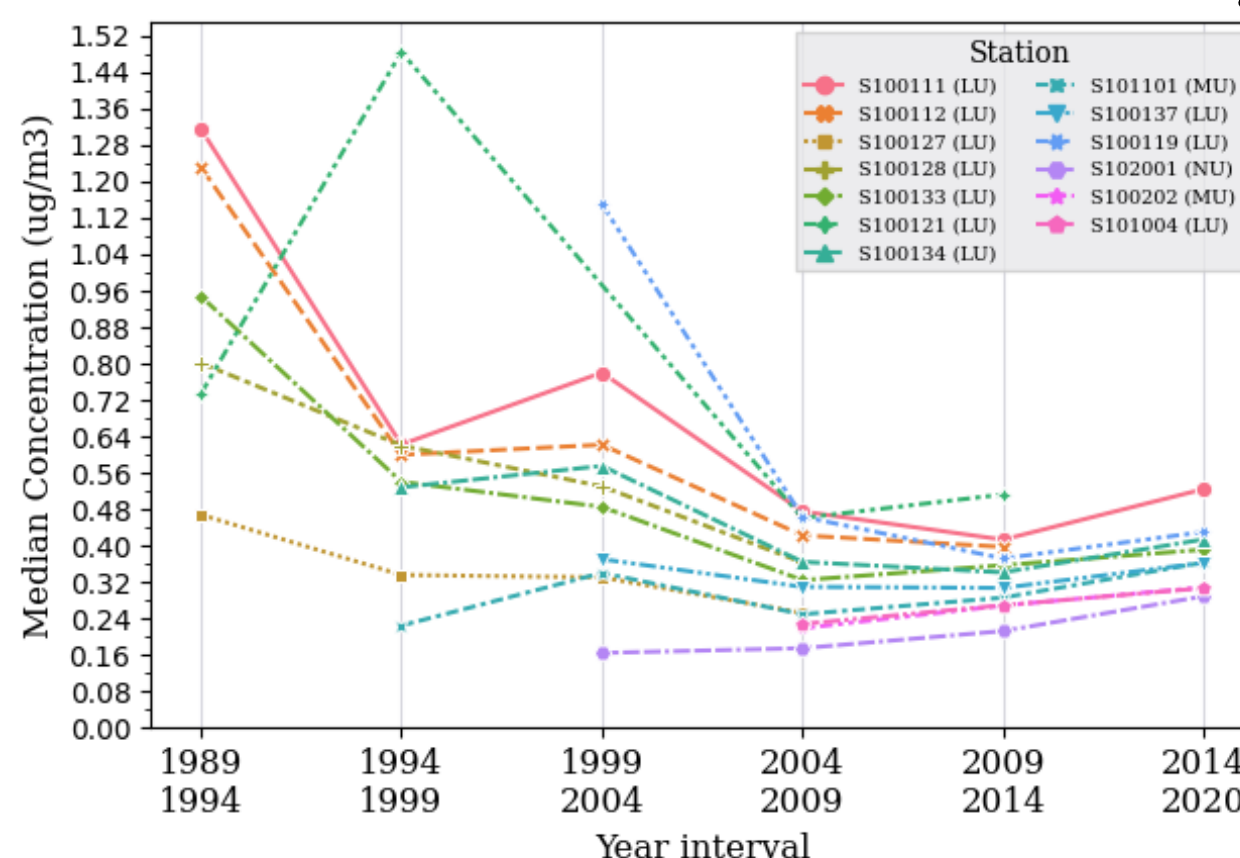


Fig. 2  
Dichloromethane concentration on a slow rise from 2009 in all stations across British Columbia. Same for all other provinces except Ontario & Quebec.

Dichloromethane concentration over time for station S090227 in Calgary, Alberta

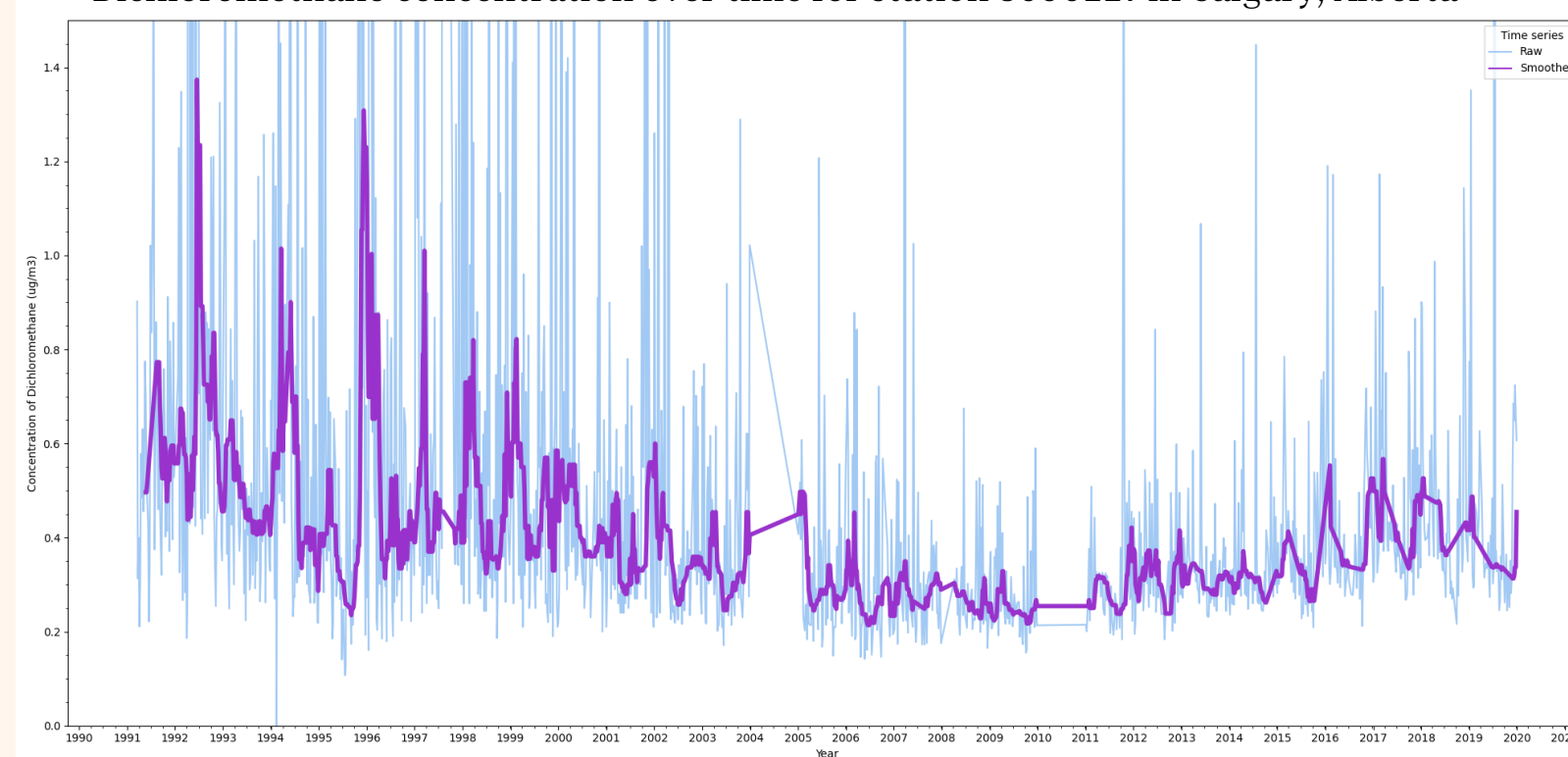


Fig. 3: A U-shaped increase in Dichloromethane concentration with a rise beginning 2010.

- Dichloromethane (DCM) is used in paint strippers (a VCP). The drop from 1995-2007 coincides with Canadian Pollution Prevention Planning plan targeting industries. [5] Recent increase possibly due to increased general population use of paint strippers or other unregulated sources.

## Results and Discussion (cont.)

### Effect of population density

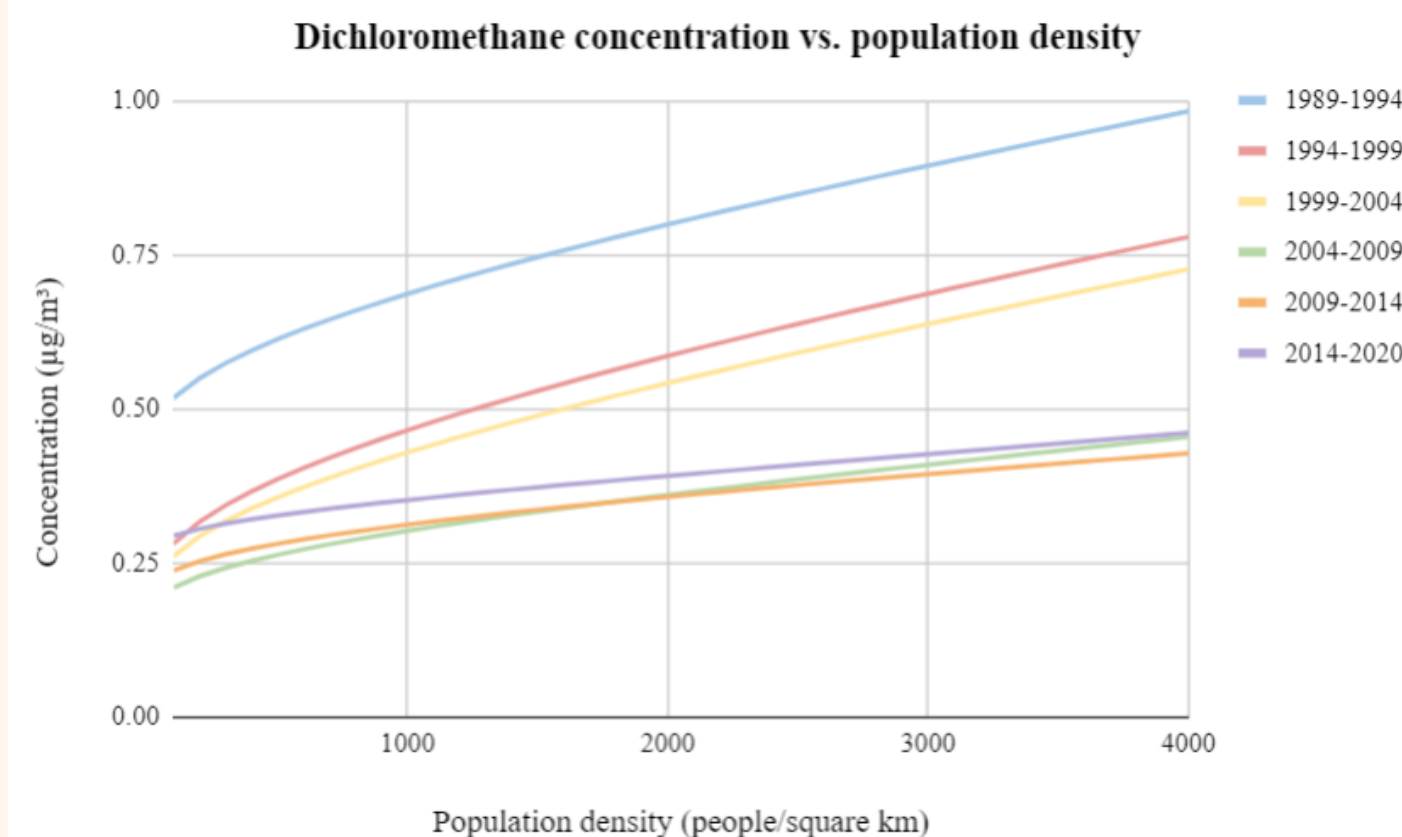


Fig. 4: Graph of the relationship between population density and dichloromethane concentration.

- In recent years, weaker relationship between population density and dichloromethane concentration.
- Increase in 2014-2019 levels likely due to other sources (eg. industrial - caffeine extraction, etc.)

## Conclusions and future work

- DCM is increasing across Canada but its source remains unclear.
- Need to do source apportionment using Principal Component Analysis (PCA) or Positive Matrix Factorization (PMF).
- Hypothesis may need to be reassessed - focus on relative rates of decrease

## Acknowledgements

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## References

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- [5] Final Report: Pollution Prevention Planning for Dichloromethane, Canada.ca, 2021. [Online]. Available: <https://ec.gc.ca/planp2-p2plan/default.asp?lang=En&n=94F95E5B-1>. [Accessed: 19- Aug- 2021]